Ashdown & Burgess

Yard Fire Protection
Of the University Buildings

Municipal & Sanitary Engineering
And Civil Engineering
B. S.
1909

YARD FIRE PROTECTION OF THE UNIVERSITY BUILDINGS

BY

EDWARD HENRY ASHDOWN

AND

HARRY HOLDRIDGE BURGESS

THESIS

For the Degree of

BACHELOR OF SCIENCE

IN MUNICIPAL AND SANITARY ENGINEERING BY EDWARD HENRY ASHDOWN

IN CIVIL ENGINEERING BY HARRY HOLDRIDGE BURGESS

IN THE

COLLEGE OF ENGINEERING

UNIVERSITY OF ILLINOIS

Presented June 1909

UNIVERSITY OF ILLINOIS

June 1, 1909

THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

EDWARD HENRY ASHDOWN

ENTITLED YARD FIRE PROTECTION OF THE UNIVERSITY BUILDINGS

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE

DEGREE OF Bachelor of Science in Municipal and Sanitary Engineering.

F. B. Saubon

Instructor in Charge

APPROVED:

HEAD OF DEPARTMENT OF Municipal and Sanitary Engineering

UNIVERSITY OF ILLINOIS

June 1, 1909

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HARRY HOLDRIDGE BURGESS

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DEGREE OF Bachelor of Science in Civil Engineering

Frank B. Sanborn
Instructor in Charge

APPROVED: John P. Brooks

HEAD OF DEPARTMENT OF Civil Engineering

A&3

The present University buildings represent an expenditure of $ 1,500,000 and the apparatus and equipment in these buildings represents nearly as great a value as the buildings themselves. In some of these buildings there are kept original records and articles of historical significance, which can have no estimated value as it would be impossible to replace them. At present the University is making a rapid growth, so rapid in fact that if the present rate continues, the entire plant will be doubled in another fifteen years. When we consider that in the United States and Canada alone, there is destroyed by fire each year about $250,000,000 worth of property, the question of adequate fire protection becomes an important one. Therefore, in choosing a thesis subject the suggestion was made by Professor F. B. Sanborn that we investigate the yard fire protection that is at present afforded the buildings of the University of Illinois; and possibly in the end make recommendations of improvements of defects that might be found to exist. The idea of investigating and making suitable recommendations was also approved by Professor White, Supervising Architect.

Our thesis has comprised:

The inspection and platting of the present system.

Consultations with the men acquainted with the present system.

An investigation of the relation of the city system to the University.

Field tests on hydrants.

Computations of present system and of proposed system.

Recommendations of proposed changes.

The investigation emphasizes:

At no building are more than three fire streams available from the University system, while in most cases four or five are required.

That the present pipe lines do not make it possible to increase the number of streams with the city connections made.

That the four-inch pipe running along Burrill Avenue should be removed and replaced with an eight-inch pipe to run as far as the Auditorium, there to connect with the six-inch pipe line.

That a six-inch pipe should be extended north from the pumping plant to connect with the six-inch running to the gymnasium.

That there should be thirteen more hydrants.

That the storage reservoir should be cleaned and roofed over, and the water used for domestic supply.

To carry on this investigation a plat of the University pipe system was obtained from Professor White. With this plat in hand and accompanied by Mr. Morrow, Superintendent of the Grounds, the system was examined and corrections and additions were noted. The location of valves and water pipes with relation to pumps and tanks was worked out and is shown here. Also a plan of the city pipes and hydrants was made.

The present University water system has two pumps; one of these is a fire pump known as a Knowles Underwriter, rated at 750 gallons a minute which means that three standard one and one-eight inch nozzle fire streams can be obtained. The second pump is the service pump and is capable of giving one good fire stream. These two pumps may be operated together to throw four streams. The domestic supply is drawn from two steel storage tanks with a combined capacity of 80,000 gallons. When full these tanks give eighteen feet head on the fire pump; as a rule, the tanks are kept, at least, three quarters full. Also, there is a storage reservoir for the supply of the pumps at time of fire. This reservoir has a capacity of 110,000 gallons. The water in this reservoir is not fit for domestic use and so it is not drawn from except in case of emergency. It can,

therefore, be relied upon to be full. The pipe line consists of an eight-inch extending as far as the University Hall where it divides in two lines extending the length of the campus; one of these is a six-inch, the other a four-inch, nearly twenty years old.

Table I shows the results of tests made in the field. These readings were taken while two streams were flowing except for hydrants numbers two and three, at which time there were two streams at number two and one stream at number three. The hydrant pressure was obtained by attaching a water guage to the hydrant by means of a piezometer ring. At the nozzle two methods were used to read the pressure, one was by using Professor Sanborn's nozzle piezometer, held directly at the end of the nozzle; the other was by means of a water guage placed at the base of the play pipe by means of another piezometer ring. Using the results of the above tests calculations were made to ascertain what losses and results would have been expected for ordinary friction of pipes. The calculated results are shown in Table II. It will be seen that the ordinary loss by friction would need to be increased about thirty percent. This would indicate that some of the pipe lines were considerably corroded and reduced in capacity. From the reports of the workmen in charge of the water system the long four-inch pipe seems to be the one at fault. A comparison of the results for hydrants number one and five seems to bear out this statement. Hydrant number one is the one most affected by the four-inch pipe and here the greatest difference was obtained between the calculated nozzle pressure and the actual nozzle pressure.

At best, a four-inch pipe has but little value in a fire protection system, and when the above defects of the present four-inch pipe are considered the four-inch pipe can hardly be said to afford fire protection. This four-inch pipe extends along the probable line of the future expansion of the University. While

at present it affords but little protection its value then will be further decreased. The four-inch and six-inch pipes as they now stand are equivalent to a six and seven-tenth-inch pipe if both were clean. It has been considered that this four-inch pipe should be replaced with an eight-inch. An eight-inch pipe as shown by table III would make it possible to obtain six two hundred fifty gallon fire stream at the Auditorium. It also furnishes pipe enough for six or seven streams at any other building in that part of the campus. The north part of the University yard has but one pipe line, a six-inch running to the gymnasium. This does not afford very good protection for the Steam Laboratory. The west end of this building can be reached from the fire pump. In case, however, the fire should break out in the north east corner it would be difficult to reach the place with a good stream. It has been thought advisable, then, to place a hydrant north of the building as proposed on the plat. The proposed location of a hydrant between the shops is also a needed change as these buildings are long and do not have adequate protection on the east end. To supply these hydrants it is proposed to run a six-inch line east of the pump house horth to Springfield Avenue there to connect with six-inch pipe along Burrill Avenue. This part of the University yard needs protection from the nature of the contents of the buildings and the use of the yards for the storage of coal.

In locating all of the hydrants thru the University Grounds, it was the intention to provide four streams for the important buildings with the present pumping facilities and six with added pumping facility. The proposed system will not give more than three streams for the buildings of less importance, as those at the farm. One of the ~~most~~ needed changes is that of cleaning the 110,000 gallons storage reservoir. This reservoir should be cleaned, and the water constantly changed by using it as a source of the domestic supply along with the two steel tanks. The main objection to the present method is the

fact that the water being impure is not drawn on until absolutely necessary, and so instead of using this water the city connections are opened and the University pumps run at a pressure corresponding to that of the city system. The reservoir is located near the power plant, and so to keep the water pure, it is necessary that the reservoir be covered.

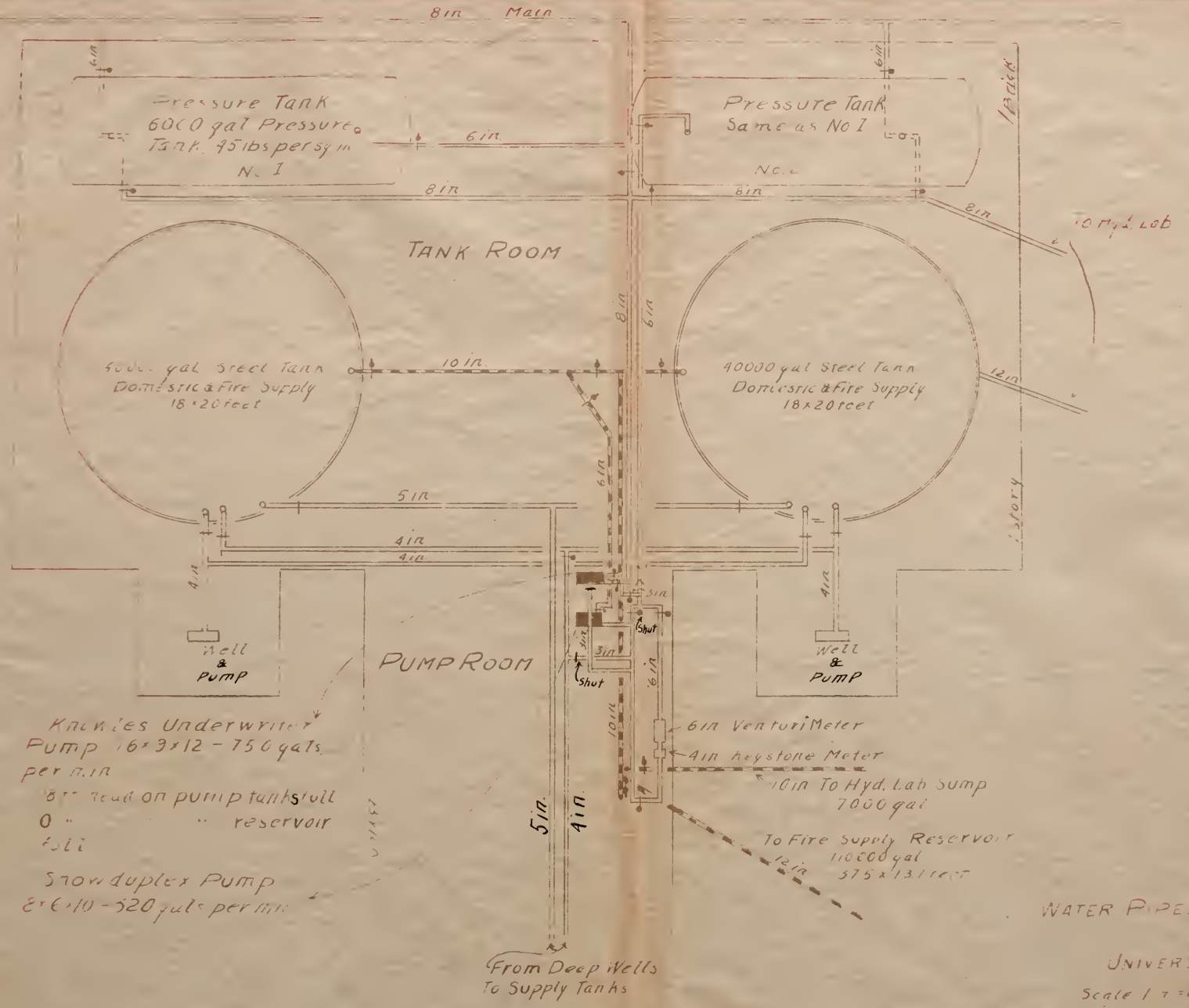
To furnish the required flow for the best protection another fire pump should be installed. This pump should be a four stream fire pump of 1,000 gallons a minute capacity. It was first considered to locate this pump in the present pump room but if a fire should break out in that room both pumps would be thrown out of commission. It was then decided to locate it in the room north of the pump room. By placing fire doors between the two rooms adjoining this room it is very improbable that fire could disable both pumps at the same time. The pump should be attached directly to the storage reservoir, by means of a twelve-inch pipe and should discharge into the six-inch pipe running east of the pump room by means of an eight-inch. Then to make the two pumps separate units the present connections with the reservoir should be cut out leaving only the connections to the steel storage tanks for the present pumps. At present the service pump alone is not capable of furnishing the required domestic supply. This is due to the fact that it must force the water thru a meter that is only four inches in size. This meter should be replaced with a larger one and the service pump used alone. This would do away with the present wear on the fire pump due to its use as a service pump.

The city has three pumps available for fire use, which are said to have a combined capacity of 5,000,000 gallons a day. The pumps are located about four thousand feet from the Engineering building. A reference to the plate of the city system shows the size and location of these pipes in reference to the University grounds. The city system is owned by a private company. This company was not

willing to furnish fire pressure for tests and so none were made. The Company, however, furnished data for a test that had been made at a hydrant at the corner of Springfield Avenue and Fifth Street, as follows: one stream two hundred sixty one gallons, pressure at pumps one hundred three pounds, at hydrant ninety pounds. It is reasonable, then, to suppose that at the University connections not more than ninety pounds can be obtained with an engine pressure of one hundred twenty pounds at the pumping plant. A reference to table II will show that with a pressure of ninety at the city connections it would be impossible to obtain the required nozzle pressure at the Auditorium for four streams. This shows that it will not be of any use to attahh to the city connections while the pumps of the University system have a supply of water to draw from. With the idea of deferring the city connections as long as possible it is recommended that the city be asked to furnish a hydrant north of the Library and one west of the Woman's Building so that hose may be attached to these hydrants for the protection of these buildings without interfering with the University pressure.

This report in main recommends that two new lines of pipe be layed, an eight-inch pipe to replace the old four-inch and a six-inch pipe to run east of the power house. With these changes the University would have a fairly effective fire system. To make it entirely adequate it is thought that another fire pump should be added. Professor F. B. Sanborn, who has had nine years practical experience as a fire protection engineer, approves these recommendations and says that with this second fire pump the University will have as highly effective yard protection system as could be desired. The above recommendations have also been talked over with Mr. Joe Morrow who has assisted us materially in supplying information for the plans and in furnishing help for making the tests. Mr. Morrow is in favor of all of the above recommendations which are now to be presented to Professor White, Supervising Architect, and we trust that he will forward them to the University trustees with his approval.

PLATE I



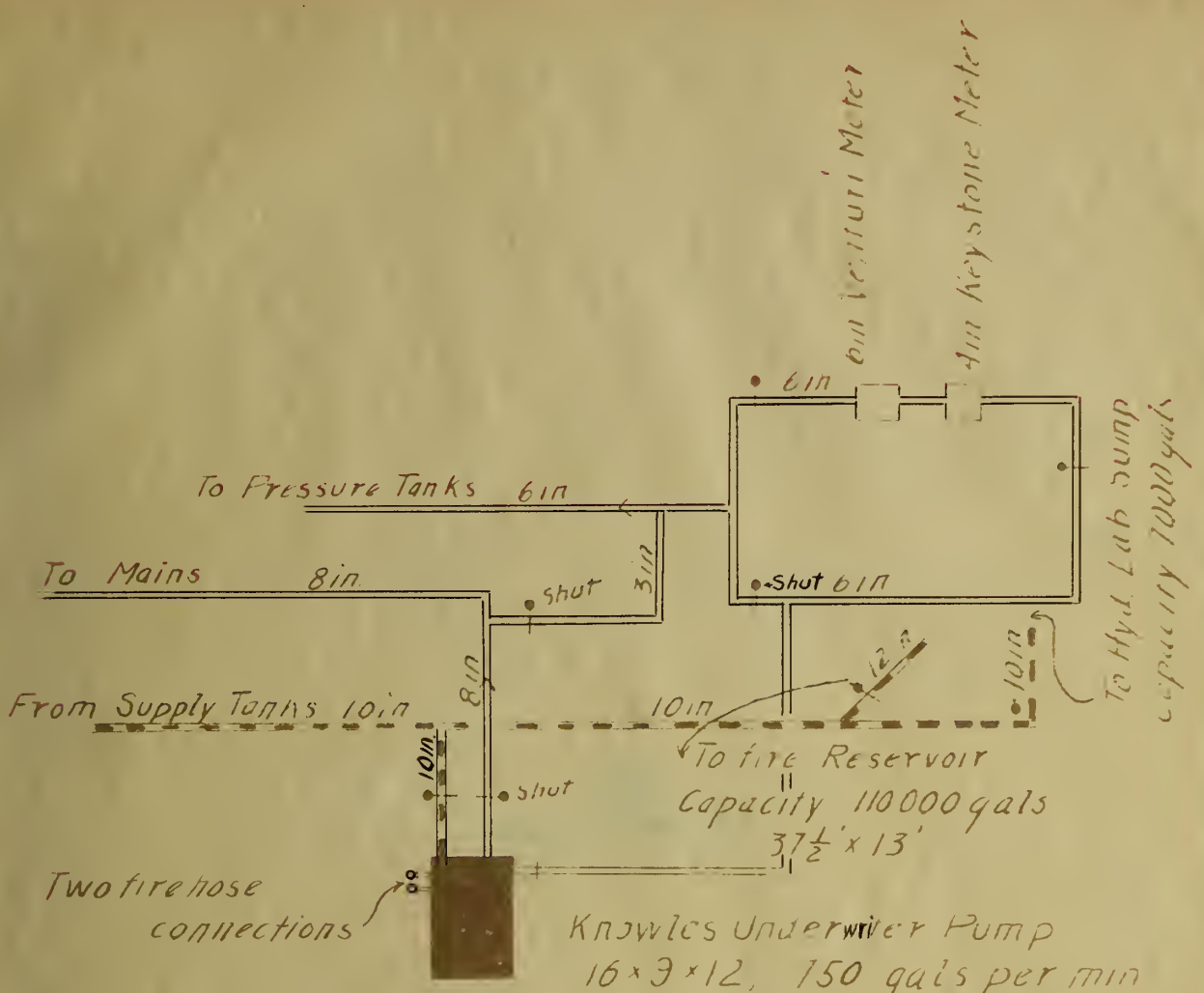
PLAN OF
WATER PIPES AT PUMPING STATION
OF
UNIVERSITY OF ILLINOIS

Scale 1" = 60'

Drawn By
H. Eastburn

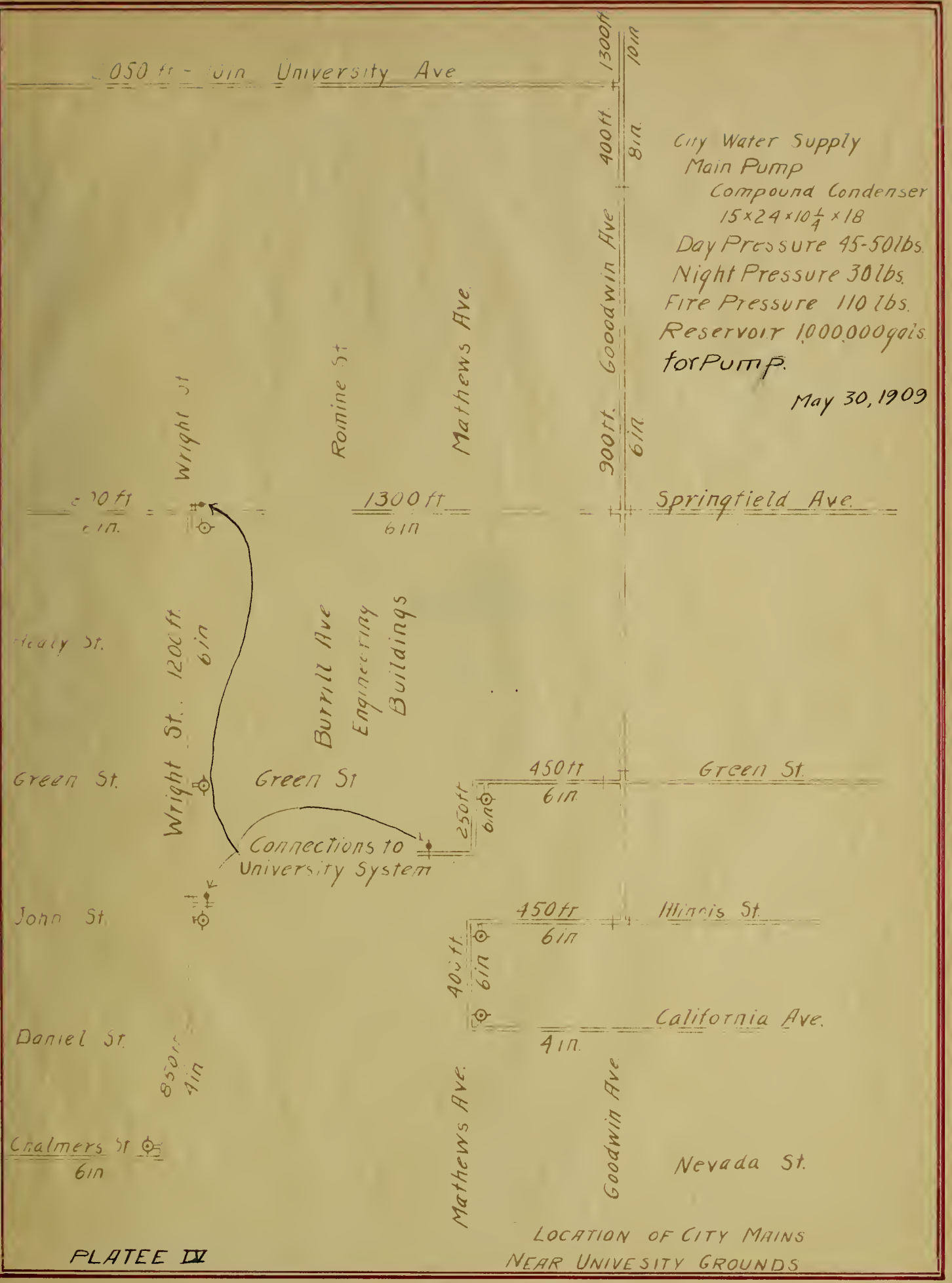
Checked By

PLATE I



ENLARGED PLAN OF FIRE PUMP
AND
CONNECTIONS

PLATE III



PLATEE IX

LOCATION OF CITY MAINS
NEAR UNIVESITY GROUNDS

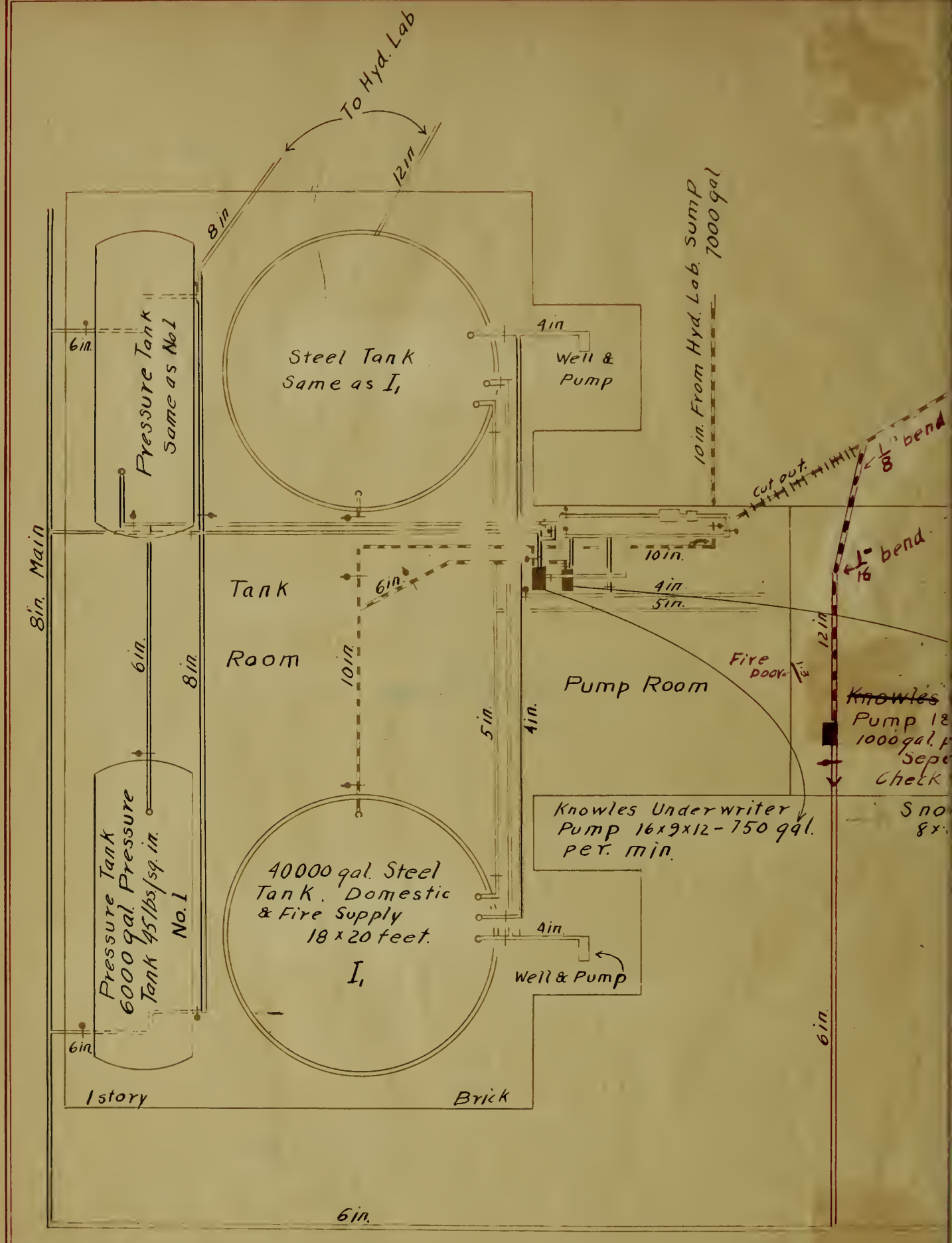
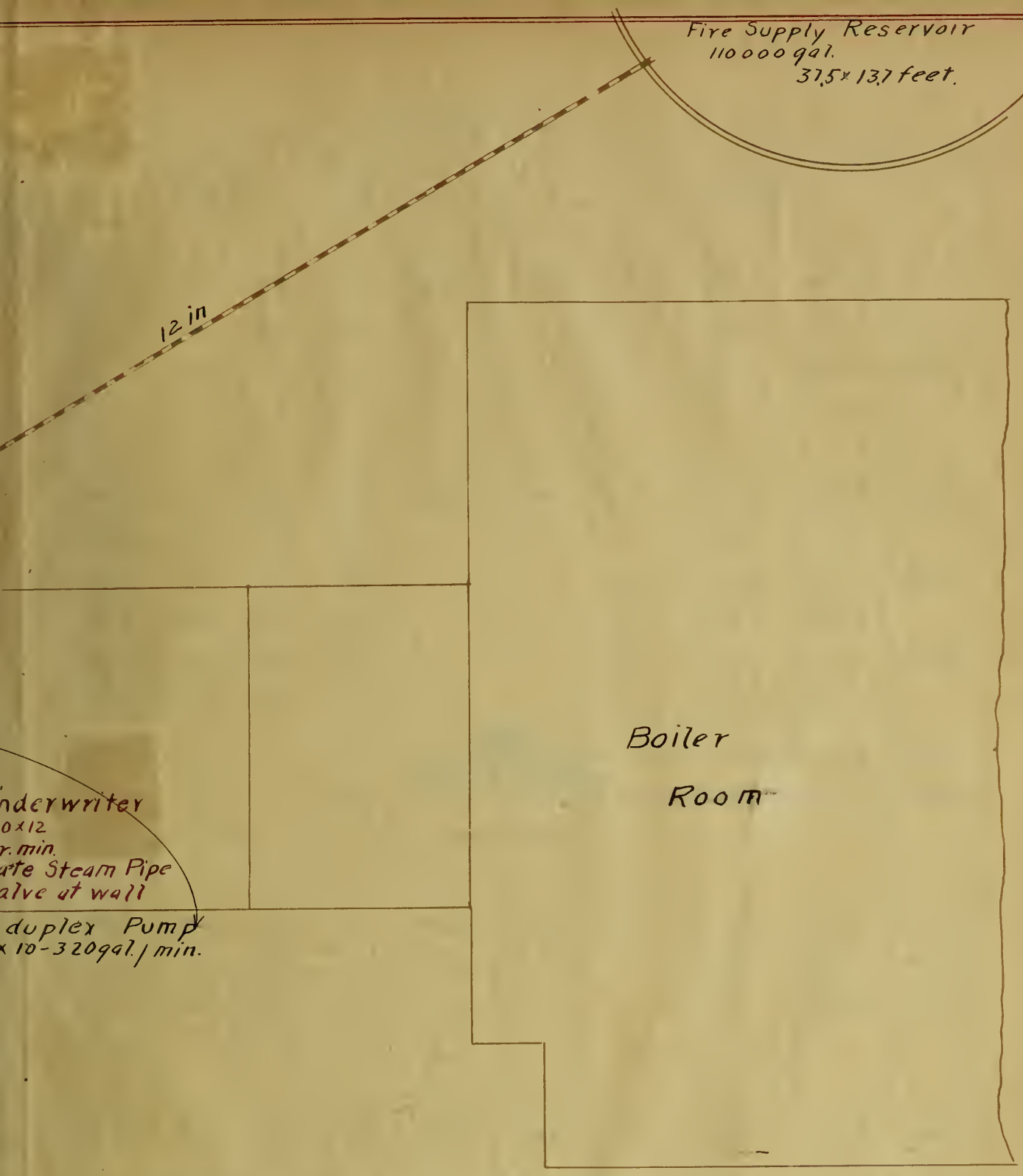

To Hyd. Lab
12in
8 in
10in. From Hyd. Lab. Sump 7000 gal
4in
Well & Pump
Steel Tank Same as I,
Pressure Tank Same as No 1
6in.
8in. Main
Cut out
1/8 bend
1/16 bend
10in.
4in.
5in.
6in.
Tank Room
8in.
10in
5in
4in
Fire door
12in
Pump Room
Knowles Pump 18
1000 gal.
Sepe
Check
Knowles Underwriter Pump 16x9x12 - 750 gal. per. min.
40000 gal. Steel Tank. Domestic & Fire Supply 18 x 20 feet.
I,
Well & Pump
Pressure Tank 6000 gal. Pressure Tank 45 lbs/sq in. No. 1
1 story
Brick
6in.

PLATE V



PLAN OF
WATER PIPES AT PUMPING STATION
AT
University of Illinois
Red lines show proposed changes
Scale 1" = 8'
May 30, 1909

TABLE I

Hydrant	Engine Pressure lbs/sq.in.	R.P.M	Size of Nozzle in.	Size of Hose in.	Feet of Hose	No. of Streams	Hydrant Pressure lbs/sq.in.	Nozzle Pressure 1st. Stream	Nozzle Pressure 2d Stream
No 1	110	60	1	2 5/8	100	2	59	47.0	46.5
	110	68	1				60	47.0	46.5
	115	61	1				61	49.5	48.4
No 2	100	78	1 1/8	2 1/2	100	2	53	36.5	36.0
No 3	100	78	1 1/4			1	55	32.5	
No 2	105	79	1 1/8			2	54	36.5	36.0
No 3	105	79	1 1/4			1	56	33.8	
No 2	103	75	1 1/8			2	54	37.5	38.0
No 3	103	75	1 1/4			1	55.5	33.0	
				In this test one stream was taken					
				from No 3 while 2 were being taken					
				from No 2					
No 5	105	67	1	2 1/2	100	2	58	47.0	45.4
	107	65					60	48.0	46.5
	110	65					63	49.0	47.5
No 4	105	63	1 1/8	2 5/8	100	2	69	50.0	50.5
	103	66					56	51.0	51.0
	100	66					65	48.0	48.0

TABLE II

Hydrant	Engine Pressure	Flow Gallons per min.	Size of Pipe in.	Length ft.	Loss per 1000 ft ft	Total Loss ft.
No 1	115	620	8.	810	9.5	7.7
		620	6.6	3000	24.0	72.0
		420	6.	400	16.0	6.0
		Total loss = 85.7 ft. = 37.3 lbs				
		37.3 x 1.3 = 48.5		1.3 = factor		h = 1.3h'
		Hose loss = 12 lbs for 100 ft hose 1 in. nozzle.				
		115 - 48.5 = 67.5 lbs hydrant		67.5 - 12 = 55.5 nozzle.		
No 5	110	650	8	810	9.2	7.5
		680	6.7	3000	21.5	64.5
		450	6.	520	22.	11.5
		Total loss = 83.5 ft = 36.2 lbs				
		36.2 x 1.3 = 47.0		Hose loss 12 lbs.		
		110 - 47.0 = 63.0		63.0 - 12 = 51.0 lbs nozzle.		
No. 2	103	910	8	810	18.0	14.6
3		320	4	800	84.0	67.2
2		600	6	1950	35.0	67.3
		Total loss = 81.9 = 37.6 lbs		37.6 x 1.3 = 49.0 lbs		
		103 - 49 = 54 Hydrant pressure at 3.				
		1 1/8 nozzle at 2 Hose loss 15 lbs.				
		1 1/4 nozzle at 3 Hose loss 22 lbs.				
		103 - 49 - 15 = 39 lbs nozzle pressure at No 2				
		54 - 22 = 32 lbs nozzle pressure at No 3				

This table is calculated from the data used in the test given on page of tests, Table I.

TABLE III

Hydrant	Flow Gallons per Min.	Size of Pipe in.	Length ft.	Loss per 1000 ft.	Total Loss ft.	Lbs Loss	Hydrant Pressure lbs/sq. in.	Loss in 250ft hose lbs.	Nozzle Pressure lbs.	Engine Press. lbs.
	1500	8	810	44.0	36.6					
No 7	1050	8	1350	23.0	31.0	28.5	91.7	45	46.7	120
No 8	450	6	1650	21.0	34.6	30.9	89.1	45	44.1	120
No 2	550	8	370	7.5	2.8	30.5	89.5	45	44.5	120
No 3	50	6	150	0.4	0.1	30.9	89.1	45	44.1	120

This table shows nozzle pressures for hydrants at Auditorium with the proposed system.